Acute Effects of Training on Hypofyse Hormon Levels in Kick-Boxers

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Abstract

This study was aimed to investigate the possible effects of acute training on hypofyse hormone levels and some biochemical analytes in kick-boxers.

The study was included 23 healthy professional male kick-boxers (age range: from 17 to 32 years and BMI range: from 19.0 to 24.2). Sportsmen were exposed to a total of 95-minute training program including training and a kick-boxing match. Venous blood samples and urine were taken from sportsmen just before and immediately after training and some biochemical analytes were analyzed.

The evaluation of pre- and post-training serum levels of analytes have shown that growth hormone, adrenocorticotropic hormone, prolactine, throide stimulating hormone, adrenalin and noradrenalin levels were significantly increased and serum insulin-like growth factor I and free thyroxine levels were significantly decreased by training. There were no significant differences between pre- and post-training serum levels of other biochemical analytes; luteinizing hormone, follicle-stimulating hormone, free triiodothyronine, cortisole and dopamin.

Our results have revealed the fact that exercise alters pituitary functions and this increment is associated with response to exercise stress. “We are in agree with the previous recommendations about regulary screening of pituitary functions and total hormonal status of competing and retired kick-boxers.”

Clinical article (J Int Dent Med Res 2016; 9: (2), pp. 133-138)

Keywords: Kick-boxing, training, sporting blows, hypofyse hormones.

Received date: 04 March 2016 **Accept date:** 05 April 2016

Introduction

There is growing interest in combat sports such as boxing and kickboxing due to the benefits of personal protection, increasing muscle strength and gaining prestige. But sporters making kick-boxing may exposed to very severe blows to the head, neck and abdomen during trainings and matches. Since the head is the master target of competing athletes, fighting sporters are under risk of acute and long term neurologic injuries. Acute neurologic injuries show a broad spectrum including mild concussion, brain hemorrhage, diffuse axonal injury and even death.[1-3] Besides these severe acute effects, the repetetive blows exposed to head and neck is related with traumatic brain injury (TBI).[4] TBI is known to be a factor leading hypofyse hormone disorders.[5] Thus, sports related hypofyse hormone disorders is a considerable field of interest.

Diagnosis of hypofyse hormone disorders related to TBI may be delayed, due to the reason that symptoms are usually seen in advanced stage. For this reason, evaluating hypofyse hormone levels in sporters exposed to traumatic brain injury is an important topic for health protection of sporters.[2,6]

Martial arts such as boxing and kickboxing are associated with chronic repetitive head trauma leading loss of consciousness, brain injury and neurological abnormalities.[7] It was shown that hypopituitarism is evolved in kick-boxing sporters exposed to chronic repetetive head trauma, particulary in those who have GH deficiency[6].

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Recently many studies have revealed that hypofyse hormone disorders are seen in some fighting and contact sports such as boxing, kick-boxing, football, ski, ice hokey and american football. [5,8] However as far as our best knowledge there is no study examining acute effects of trauma and blows on hypofyse hormone levels. In this study we aimed to evaluate the acute effects of training and fighting on hypofyse hormone levels in kick-boxing sporters.

Materials and methods

Participants

23 healthy professional male kick-boxers who had been making training for 2,5 hours/day and 4 days/week. The mean age of kick-boxers was 20.08 ± 6.33 years and the mean sports duration was 6.2±1.4 years. The study protocol was approved by an institutional ethical board (02.09.2013/ b.3.0.2.ATA.0.01.00/139). Informed consent was obtained from each participant and patient anonymity was preserved. A sports history survey was administrated to all participants which included some questions about inquiries caused to head trauma, total sports duration, number and intensity of blows exposed to head, knock-out and helmet usage status.

Exercise Protocol

Sportsmen were subjected to a to training program lasted for 95-minutes. The program was consisted of 15 minutes of jogging, 30 minutes of warm-up, stretching and opening exercises, 50 minutes of technical and tactical applications. Then all sporstmen made a kick-boxing match in accordance with the fight rules of International Kick-boxing Federation. The match was consisted of three raunds of each raund lasted for two minutes. The sportsmen took a rest for one minute between raunds. The total activity including training and match was called as training.

Following this training, kikcboxers were underwent to a 6-minutes kick-boxing match consisted of three raunds of two minutes (one minute resting between raunds) in accordance with the fight rules of International Kick-boxing Federation and the total activiy was called as training. The loading force was about 40-70 % and pulse intervals were about 130-160.

Biochemical analysis

Body composition of sportsmen were measured with a bio-impedance analysis system (Tanita TBF 300). Venous blood samples were taken from sportsmen and sera were obtained. Blood samples were obtained twice: just before and immediately after training. Serum free triiodothyronine (FT3), free thyroxine (FT4), throide stimulating hormone (TSH), follicle-stimulating hormone (FSH), luteinizing hormone (LH), prolactine (PRL), cortisol, levels were measured in Beckman Coulter DxI 800 (Beckman Coulter, CA, USA) analyzer by the respective methods. Serum growth hormone (GH), adrenocorticotropic hormone (ACTH), and insulin-like growth factor I (IGF-I) levels were measured in Siemens, Immulite 2000 (Siemens Healthcare GmbH, Erlangen, Germany) with chemiluminescence method. Urine adrenalin, noradrenalin and dopamine levels were measured by HPLC-FLD analyzer (Agillent 1100). Considering that decrements in the plasma volume will affect post-exercise concentrations of analytes, an adjusment was performed using a formula suggested by Dill and Costill.[9]

Statistical analysis

Kolmogorov-Smirnov test was used to evaluate the normality of parameters. SPSS statistical software package (SPSS, v.20.0 for Windows, SPSS Inc. Chicago) was used fort he statistical analyis of data. Data were presented as mean±standart deviation for normally distrubuted parameters and median and minumum-maximum values were presented for not-normally distrubuted parameters. Paired t-test was used to evalauate the statistical significance between pre-training and post-training values.

Results

Twenty-three healthy professional male kick-boxers who had been making kick-boxing sports for at least 5 years and had been training for four days per week were included to the study. The mean age of sportsmen was 20.08 ± 6.33 (ranged from 17 to 32 years) and the mean body mass index (BMI) of sportsmen was 22.11 ± 3.04 (ranged from 19.0 to 24.2). All sportsmen were successful at regional level. None of the sportsmen were using alcohol and 8% of sportsmen were smoking.

The results of sports history survey administrated to all participants showed that the mean sports duration of sportsmen was 6 years and 97 % of sportsmen had been using helmets during training and matches. Furthermore, the answers given to the questions about taking blows to the head have showed that, the number of average blows per training was 15, 90 % of blows were considered as normal and/or mild by means of severity, 63 % of sportsmen among those who had blows on the head or who had knock-out had also headache complaint, 17% of sportsmen had leaved the training because of these complaints and one (4.3 %) sportsmen was taken to the hospital. 8 (34.8 %) sportsmen had been knock-outed during matches and the most frequent reason of knock-out was the blows taken to the stomach and liver.

Blows taken to the head in per training [n (%)]		**The severity of blows taken to the head [n (%)]**	
15-25	9 (39)	Severe	7 (31)
25-35	6 (26)	Normal	10 (44)
35-45	5 (20)	Mild	6 (25)
45-55	3 (15)		
Knock-out status n(%)]		**Knock-out region [(%)]**	
Yes	8 (35)	Stomach	3 (37.5)
No	15 (65)	Liver	3 (37.5)
		Nose and jaw	2 (25)

Table 1. Survey results about blows taken to the head and knock-out status in sporstmen.

Parameters	Pre-training	Post-training-1	Post-training-2	p
Age (years)	20.08 ± 6.33	-	-	-
Height (cm)	171.47 ± 4.74	-	-	-
Body weight (kg)	65.20 ± 10,41	64.43 ± 10.33	61,20 ± 9,81	<0.001*
BMI (kg/m²)	22.11 ± 3.04	21.90 ± 3.03	20,80 ± 2,87	<0.010
LBM (kg)	59.69 ± 8,46	58.97 ± 8.46	56,02 ± 8,03	<0.001
TBW(kg)	43.70 ± 6,19	43.16 ± 6.19	41,00 ± 5,88	<0.001

Table 2. Demographic characteristics and body composition values of sporstmen and test statictic p values.
BMI: Body mass index, LBM lean body mass: TBW: total body fluid, p: test statistic p value, *:p<0,05.

The average body weights of sporstmen was significantly decreased from 65.20±10.41 kg to 62.08±16.87 kg by exercise (p<0.001). An adjustment was performed to all post-exercise values in order to fix the dilutional increment (about 5%) caused by plasma volume loss according to the recommendations of Dill and Costill.[9] The adjusted post-training values are given in Table 3.

Parameters	Pre-training	Post-training-1	Post-training-2	p
GH (ng/ml)	2 ± 1.79	3.17 ± 2.64	3.01± 2.50	0.000*
IGF-I (ng/mL)	366.41 ± 98.96	297.73± 68.82	282.84 ± 65.37	0.000*
ACTH (pg/mL)	22.03 ± 8.33	38.48 ± 19.35	36.55 ± 18.38	0.000*
Cortizol (mcg/dl)	7.60 ± 3.46	9.48 ± 4.46	9.00 ± 4.23	0.053
PRL (mlu/ml)	9.04 ± 4.16	12.60 ± 5.00	11.97 ± 4.75	0.001*
TSH (µU/ml)	1.64 ± 0.70	2.21 ± 0.98	2.09 ± 0.93	0.003*
FT3 (nmol/l)	3.20 ± 0.30	3.22 ± 0.35	3.05 ± 0.33	0.714
FT4 (nmol/l)	0.89 ± 0.11	0.85 ± 0.09	0.80 ± 0.08	0.014*
LH (mIU/ml)	3.02 ± 1.82	3.44 ± 2.06	3.26 ± 1.95	0.250
FSH (mIU/ml)	3.88 ± 2.35	4.07 ± 2.77	3.86 ± 2.63	0.616
Adrenalin (pg/ml)	15.11 ± 11.77	30.71 ± 23.14	29.17 ± 21.98	0.004*
Noradrenalin (pg/ml)	54.27 (26.04-274.09)	100.25 (20.09-1432.02)	95.23 (19.08-135.86)	<0.011*
Dopamin (pg/ml)	228.64 (21.31-7117.23)	333.57 (67.14-5432.42)	316.89 (63.78-5160.79)	0.052

Table 3. Serum hypofyse, thyroid hormon and urine catecholamine levels in sportsmen and test statistical p values between pre-training and post-training values.
GH: Growth hormone, ACTH: adrenocorticotropic hormone, PRL: prolactin, TSH: thyroide stimulating hormone, IGF-I: insulin-like growth factor I, FT4: free thyroxine, cortizol, FT3: triiodothyronine, LH: luteinizing hormone, FSH: follicle-stimulating hormone, p: test statistic p value, *:p<0,05.

Evaluating adjusted post-training and pre-training serum levels of analytes have shown that, serum GH, ACTH, PRL, TSH and urine adrenalin and noradrenalin levels were significantly increased by training (p<0.05 for all parameters). There were no significant difference between pre- and post-training serum levels of LH, FSH, FT3, cortizol and urine levels of dopamin (p>0.05 for all parameters). (Table 3).

Discussion

In this study we aimed to evaluate the acute effects of exercise on serum hypofyse hormone levels and urine catecholamine levels. Our results have shown that serum GH, ACTH, PRL and TSH levels were significanlty increased and serum IGF-I and FT4 levels were significanlty decreased by training.

Sports related traumatic brain injury is indicated to be the most prominent reason of hypofyse hormone deficiencies. ACTH and GH are indicated to be the markers of hypofyse hormone deficiencies. Hypofyse gland damages are seen in people making fighting sports related with traumatic brain injury.[3]

A study conducted on 22 elit kick-boxing sporters have shown that serum GH, IGF-1 and ACTH levels were statistically significantly decreased by exercise compared to healthy controls.[10] Results of another study conducted on 61 boxers and 29 kick-boxers have shown that serum GH, IGF-1, ACTH, LH and PRL levels statistically significantly lower in kick-boxers compared to healthy controls and there were no significant differences in terms of $FT_{3,}$ FSH and cortizol levels between groups. Results have shown that 15% of sportsmen had GH deficiency and 8% of sporstmen had ACTH deficiency.[6] A similar study has revealed that serum ACTH levels were significantly lower in boxers compared to sedantary healthy people.[11] GH decrements about 58 % were reported in fifteen people with severe traumatic brain injury history.[12] Aforementioned results pointing hypofyse hormon decrements or deficiencies are generally incompatible with the results of our study.

Studies in the literature generally have revealed that exercise is a stimulant of stress in the body and exercise alters hypofyse hormon levels by affecting homeostasis. The increments in the hormon levels caused by exercise has an important role in maintaining homeostasis by facilitating adaptation to exercise.[13-15] In a study conducted on Rolandi et al., sporters from different branches and sedantary controls were underwent to bicycle pedal rotation. Results have shown that serum GH and cortisol levels were increased in volleyball players and sedantary group and serum PRL levels were increased in only in volleyball players.[16]

It was reported that LH, FSH and TSH levels didn't significantly altered in both groups. Similarly, in a study conducted on triathlon and speed skating sporters by using different loading forces on bicycle ergonometer; it was shown that whereas serum GH, ACTH and cortisol levels were significantly altered by exercise, there were no significant differences in terms of serum LH, FSH, TSH, IGF-1 and FT4 levels after exercise.[17] It was shown that an acute increment has shown in GH response both in aerobic and anearobic trainings.[18] Serum GH levels are reported to be increased in skiers and footballers by training but there was no acute significant alteration in terms of serum IGF-1 levels.[14]

Diminished serum IGF-1 levels were reported in children making intense football training for 90 minutes[19], young wrestlers[20] and cross country runners.[21] Serum IFG-1 levels and GH levels were reported to be increased in athletes running on a cycle ergonometer.[21]

In a study Hackney et al., have subjected sporters to run on a treadmill till they feel tired and analyzed serum hormone levels. It was shown that all hormones were increased by baseline, serum FT3, FT4 and TSH levels were decreased on 30th and 60th minutes and later serum levels of hormones were returned to their basal levels. Same study have revealed that serum cortisol and prolactin levels were returned below the basal levels after twenty-four hours.[22] TSH and FT4 levels found to be increased and FT3 levels were found to be unchanged after aerobic exercise with different loading forces (mild at 45 %, moderate at 70% and high at 90% intensities) in 60 elit sporters.[23]

Additionally, serum TSH levels are reported to be altered in swimmers.[24] A study conducted on weight lifters has shown increased serum FT3 and FT4 levels depended on the intensity of training, and it was seen that this increment returned to normal levels later.

There are studies in the literature reporting decreased serum LH and FSH levels by acute exercise in elit sporters.[11,25] In a study conducted by Tabata et al., it was shown that whereas serum LH and FSH levels were increased after 800-meter run, the serum levels of LH and FSH didn't show changes in bicycle ergometer exercise lasted for 90 minutes and 36-km of cross country exercise.[26,27]

Many studies have demonstrated that serum prolactin levels show variations depended on the duration of exercise. In a study conducted by Luger et al., it was shown that whereas no response was seen in prolaction secretion at 50 % VO_2max intensity, a slightly increment was seen at 70 % VO_2max intensity and serum prolactin levels were significantly increased at 90 % VO_2max intensity.[28] Similarly, serum prolactin levels are shown to be increased in continous running group training in hot environment.[29]

Studies in the literature have shown that hypofyse hormon deficiencies are generally seen in people making fighting sports and hypofyse hormones are proned to be increase after exercise. In our study whereas pre-training hypofyse hormone levels were in normal ranges, hypofyse hormone levels were increased by training. Evaluating the results of biochemical analytes with the results of sports history survey we can conclude that traumatic brain injury is a prominent risk in sporters making fighting sports like kick-boxing, and long term monitoring of these sporters is recommended.

Many studies conducted up to date have shown that exercise is a stimulant of stress in the body and may affect many hematologic and biochemical parameters. “Adrenalin and noradrenalin are known to be increased secondary to the stress in both aerobic and anaerobic exercise in order to induce the adherence of the body to the stress.[30,31]”One of these studies has shown that adrenalin and noradrenalin levels are increased in strength trainings in a loading intensity depended manner.[32] Similary, exercise has shown to increase catecholamine levels in different branches of sports requiring strength; like running, bicycle ergonometer, swimming, fast-paced walking.[33,34]

Our results revealed the literature reporting increased adrenalin and noradrenalin levels by training. Serum GH and ACTH levels are reported to be deficient in a coach group making fighting sports. In our study mean sports duration of sporters was 6 years and 95.2% of sporters had reported that they use helmets. Considering that active duration of sports is more in coach group than that of in young sporters group and the coach group have stated that they didn’t use helmets during their sports duration, we can conclude that hypopyse hormone deficiencies may be affected from the long duration of sports and helmet usage.

Conclusions

“We can conclude that shots blowed to head may lead to traumatic brain injury in kick-boxers and sporters in other fighting sports should be monitored in short and long terms for hypopyse hormone deficiencies.”

Declaration of Interest

The authors report no conflict of interest and the article is not funded or supported by any research grant.

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